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of a Regional Network for Microelectronics
in the ECLAC Region (REMLAC)*

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REPORT ON THE UNIDO MISSION PREPARATORY TO THE ESTABLISHMENT OF A REGIONAL SYSTEM FOR MICROELECTRONICS IN LATIN AMERICA (REMLAC)**

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Introduction

A number of regional meetings have revealed the importance of microelectronics in Latin America. It has become clear that this technology can provide an impetus to the industrial development of the region, on the one hand, by creating opportunities for the establishment of new rapid-growth enterprises and, on the other, by providing equipment and services that will have the effect of improving the efficiency and competitiveness of many other economic sectors.

Within this framework, the importance has been recognized of establishing mechanisms to encourage and support regional co-operation in the field of microelectronics, with specific reference to research and development, training, and industrial and commercial complementarity.

In the light of these facts, the United Nations Industrial Development Organization (UNIDO) is sponsoring a meeting to be held during the month of June 1985 for the purpose of defining the scope of the "Regional System for Microelectronics in Latin America" (REMLAC) and of identifying the machinery required to initiate its activities.

The purpose of this mission was to review the activities being conducted in this field in Argentina, Brazil, Venezuela and Mexico and to suggest specific areas of interest to serve as a basis of discussion with a view to achieving concrete results at the June meeting.

The mission found that the policies pursued in all the countries visited accorded priority to the development of microelectronics, not only in terms of applications, but also with respect to the promotion of the design and local production of hybrid and special circuits. The most important areas of application are telecommunications and data-processing, which share a number of common components, so that as a matter of policy these two fields and microelectronics as such are coming to be increasingly regarded as an integrated whole.

Attention should also be called to the relationship that exists, from the technological standpoint, between microelectronics per se and such applications as photovoltaic cells, lasers, power transistors and solid-state devices in general. There is no question that a microelectronics development strategy will spark off advances in other areas as well.

There already exists in Latin America an installed microelectronics capacity both at the governmental level and in the industrial sector as such. This potential varies from country to country, but all the countries visited possess the necessary assets for rapid expansion in the microelectronics area, viz:

(1) All the countries visited have strong university programmes in microelectronics coupled with extensive experience in the training of the necessary human resources.

(2) Similarly, there are government research and development institutions that maintain close ties with the universities and are actively working on the application of microelectronics to the various problems of

national industry. As a result, each country has developed a specific capacity which, although occasionally overlapping that of the other countries, also represents a useful element of complementarity in regional co-operation.

(3) In each of the countries visited there is an expanding national industry which operates with original designs and which is generating an ever-increasing demand for the domestic development and manufacture of electronic circuits and components.

(4) Each of the Governments has formulated or is in the process of formulating a comprehensive programme which, albeit at different stages of maturity, covers the full range of activities in the areas of microelectronics, electronics and data-processing.

The visits carried out revealed that microelectronics has advanced very rapidly in the Latin American region in recent years to the accompaniment of dramatic growth in the existing infrastructure. In the case of Brazil this infrastructure is already supplying the national and international market, and is beginning to supply the national market in Venezuela, Mexico and Argentina, although the principal trend in these latter countries has been towards the manufacture of electronic equipment for a variety of applications.

This entire picture points to the need to develop a production capacity for electronic components at the regional level not only because of the strategic importance of this capacity, but also because of the economic benefits to be gained from the supply of the domestic market and from the existing export potential.

Within the region there is great interest in the establishment of the REMLAC System, as indeed in all forms of co-operation in the microelectronics area. In every case the persons interviewed (see annex II) showed keen interest in the REMLAC concept, since it is quite clear that heavy pressure is being brought to bear both by the developed countries and the transnational industrial groups and that no country can aspire to cover all the areas simultaneously and competitively.

Similarly, the existence of this marked regional interest is reflected in Decision No. 221 of the Tenth Council of the Latin American Economic System (SELA), inspired by the Quito Declaration and Plan of Action and the informal meeting on data-processing and microelectronics held in Caracas in 1985.

Research and development

Since microelectronics is an eminently high-technology field, it is essential that its growth should be based on research groups backed by an adequate infrastructure. It is worth while noting that the four countries visited have for more than ten years been conducting programmes both in the field of microelectronics *per se* and in such related areas as solid-state physics, chemical processes, etc., with the result that they now have trained specialists currently engaged in research, teaching and industrial activities. These groups represent a valuable asset for the promotion of progress in this area.

In Venezuela, the Engineering Institute Foundation (FII) has succeeded in establishing an infrastructure associated primarily with hybrid circuits, fibre optics, power transistors and microprocessors. The Foundation has a staff of 23 research specialists and adequate pilot-scale industrial facilities, at which new technologies can be brought to full maturity before they are put to industrial use. The Venezuelan Institute of Scientific Research (IVIC), which employs two research specialists, also has experience in the design and manufacture of integrated circuit devices and has begun work on computer-assisted circuitry design. IVIC has trained the personnel who now form the greater part of the technical staff of the Engineering Institute Foundation and has supplied most of

the current directors of the country's professional design enterprises. At Simón Bolívar University there are also two groups totalling four researchers involved in the study of photovoltaic cells.

In Brazil there are many research groups working in the microelectronics field. The most important are to be found at the University of São Paulo, Campinas University, the Data-Processing Technology Centre and the Telebras Research and Development Centre. The result has been the gaining of experience, already transferred to the industrial sector, in the manufacture of semiconductors, the design of integrated circuits, the production of hybrid circuits and in technologies relating to power transistors, solar cells and fibre optics.

The Brazilian research infrastructure in this area has substantial growth potential and constitutes a Latin American asset that can be used to support the efforts being undertaken in other countries.

Microelectronics research in Argentina is concentrated primarily at the National Centre for Electronic Component Research (CENICE), which is a part of the Armed Forces Technology Centre (CITEFA). The technology developed by CENICE in hybrid circuits is being passed on to industry. The major printed circuit companies were formed from CENICE personnel and are currently working on the design of integrated circuits and on the manufacturing processes for these circuits, with particular emphasis on CMOS technology.

Also within CITEFA, the PRINSO (Solid-State Research Programme) group has extensive experience in infrared detectors and solid-state batteries using original technologies, some of which have already been transferred to industry. There is also a group at La Plata University working on the computer-assisted design of circuits and digital data networks.

In Mexico research has focused on integrated circuits and solar cells, primarily at the Centre for Research and Advanced Studies of the National Polytechnical Institute, the National Institute of Astrophysics, Optics and Electronics, Puebla University, and within a number of groups at the National Autonomous University of Mexico.

Co-operation in research and development may be very fruitful in view of the common interest in such subjects as: computer-assisted design, design and manufacture of special integrated circuits, the supply of electronic-grade materials and inputs, the design and production of power devices, fibre optics, and test and measurement technologies for quality control and as certification aids in microelectronics and other fields.

Extensive contacts already exist between the research and development groups working in the microelectronics area in Latin America. For example, Argentine, Venezuelan and Mexican specialists can frequently be found attending seminars and meetings on microelectronics organized in Brazil. It would be useful if at these conferences and at those of other related professional groups (e.g., groups working in solid-state physics and computer sciences, among others) round-table discussions and special meetings could be organized for the purpose of analysing Latin American co-operation in microelectronics research and development. This would provide a means of identifying subjects of common interest for information exchanges and the formulation of co-operative projects. It is interesting to note the similarity between the work carried out by the International Electrical Research Exchange (IERE) and the REMLAC concept, since IERE has no permanent secretariat, this body relocating every 18 months to the venue of the next meeting, from where the activities for that period are co-ordinated. On the other hand, the existence of national plans in the field of microelectronics, together with the setting of the associated priorities and the assignment of specific tasks, also represents a significant supporting factor in promoting research and development co-operation.

It might be suggested, in this respect, that the focal points of the System should undertake to provide the national agencies involved in promoting, co-ordinating and/or conducting research with information on the plans and achievements of the other countries of the region. It would also be useful if periodic, perhaps biannual, meetings could be arranged to analyse co-operation between various countries in research and development, similar to the meetings organized by the International Electrical Research Exchange, in which every 18 months research groups from many countries come together to discuss and describe their research programme and the principal results achieved. It is important to note that for Latin America there already exists the Hispanic-American Association of Telecommunications Research and Studies Centres (AHCIET), which has maintained a busy schedule of meetings for exchanges of information and the encouragement of collaboration between the Latin American countries.

Meetings of the kind proposed would be sponsored by the System and would provide a forum for general reviews of the state of the art in research and development in each of the countries, as well as for discussions of priority areas of interest selected by common agreement at the previous meeting. Exchanges of this type would supplement the expert group meetings convened to analyse specific details not only in the form of seminars and workshops, but also through discussions, training and the implementation of the joint projects formulated under the System.

As a supporting activity in furtherance of research and development co-operation, it would be useful if every country were to publish and disseminate bibliographical information on studies completed along with lists of projects in the process of implementation in this field. To this end, it should be possible to use the experience gained by such institutions as the Centre for Scientific and Humanist Information of the National Autonomous University of Mexico in the preparation of Latin American bibliographies and indices. Similarly, these activities could be pursued through the journals that already exist in several countries, such as TEC in Venezuela and the Revista Telegráfica Electrónica in Argentina.

Training

More than 20 Latin American universities (see annex I) offer programmes in microelectronics ranging from the design and production of printed, hybrid and integrated circuits to the fundamental concepts required for the manufacture of new materials and devices for use in electronics.

Universities such as those at São Paulo and Campinas offer programmes covering a wide range of the activities mentioned, whereas others (e.g., the National University of the Coast in Argentina) deal with very specific problems, such as the production of electronic-grade materials.

It would be useful if there were greater co-operation between all these institutions for the purpose of more effectively using the experience available in the region with respect to:

- Educational objectives;
- Study programmes;
- University-industry relations;
- Manager training;
- Infrastructure development;
- Co-operation among the universities and institutes of the region.

There might also be planning of post-graduate programmes of a complementary nature, covering in greater scope and depth a range of topics relating to various scientific and technological aspects of microelectronics. As a short-term measure, teacher exchanges and fellowship financing could be encouraged, both for the organization of post-graduate courses as well as for on-the-job training.

It would seem useful for the post-graduate programmes to address the great demand for specialists in microprocessor and electronic engineering applications which are of fundamental importance in enabling each country to develop the kind of electronic design capacity required for the generation of microelectronics demand. This design capacity must reflect the specific needs of each country, with particular reference to the logical and electrical aspects of circuit design. It would also seem advisable to cover the areas of telecommunications and data-processing, along with the circuitry required for the monitoring and control of equipment and processes.

It is likewise important that post-graduate programmes be introduced in the area of computer-assisted design, including the development and use of simulators, and on the processes employed in the production of integrated circuits, such as metal deposition, mask production, diffusion, etc.

In general, there is evidence of great interest in ensuring good basic training through the post-graduate programmes, with this approach supplemented by the kind of research and development activities that will slant the training towards the specialized areas of the research groups.

Considering the heavy investments required for these research groups, it has been deemed advisable that the post-graduate programmes should be planned in accordance with complementarity criteria permitting more effective use of resources.

The information gathered does not permit a more detailed analysis of the modalities and objectives of a Latin American co-operation plan for human resource training in microelectronics; however, it is worth while noting the importance ascribed to this subject in all the countries and the interest expressed by the institutions of higher learning in improving their co-operative ties with other institutions of the region. Accordingly, it is strongly recommended that, as part of the System's activities, consideration should be given to the organization of periodic, possibly biannual, meetings during those years when the research and development meetings previously suggested are not held, for the purpose of improving inter-institutional communications, discussing collaborative regional measures and strengthening bilateral co-operation.

Considering the rapid pace of change in the field of microelectronics and the intensive programmes in advanced areas conducted by many universities outside the region, it is essential that efforts be continued to train specialists, primarily at the doctorate level in other countries, by taking full advantage of the contacts that already exist and by capitalizing on the region's negotiating strengths. It should be stressed that excellent relationships already exist between Latin American institutions and universities and universities in various other countries of the world, such as Stanford, Berkeley, M.I.T., Rochester, North Carolina, Waterloo, Edinburgh, Toulouse, Aachen, Nagoya, etc.

Contacts have also been established with universities in Korea, Taiwan and India, and it would seem advisable to make maximum use of the potential opportunities for co-operation with these institutions.

The Latin American electronics industry

The Latin American electronics industry has made a major effort to develop machinery in support of regional co-operation. One result has been the

establishment of the Latin American Association of the Electronic Industry (ALAINEE) and of the equivalent association for the Andean Pact countries (ANDINEE). Unfortunately, there has been a substantial reduction in the activities of these associations, in part because of the general recession that has struck the countries of the region, but also for the reason that these activities were focused primarily on industries producing electronic products for mass consumption - an area in which all the countries have developed their own capacity and in which there were few opportunities for co-operation. The measures now being taken in a number of countries of the region with a view towards developing the electronics industry through growth in telecommunications, data processing and microelectronics are leading to new possibilities for co-operation. What are involved are more sophisticated products and technologies that have a more extensive range of applications which cannot all easily be mastered by any single country. New problems are also emerging in connection with the supply of components, materials, precision parts and services, which are of interest to all manufacturers. The same is true of the computational tools required for design and for the technological support of production processes, quality control and certification.

These fresh opportunities for co-operation are opening up rapidly as the industries in question experience dramatic growth. It may be said that it was in 1983 that these related problems began to become more clearly delineated - problems that are acquiring ever greater importance as new industrial enterprises come into being and their volume of production increases. Consequently, it would be extremely useful if the REMLAC System were to promote communications and exchanges and, at a later date, co-operation between the industries of the different countries of the region.

Considering that nearly all the fast-growing enterprises in this field operate their own research and development programmes, industrial co-operation may lead to joint developments and, in all likelihood, to new financing arrangements, such as the bilateral risk-sharing schemes that have been promoted by the National Council for Science and Technology of Mexico, or to regional machinery for the financing of research and development projects conducted by industrial enterprises in collaboration with research institutions.

More broad-based co-operation activities, backed by governmental support, might serve as the basis for a Latin American microelectronics development programme, similar - although surely far smaller in scope - to the European SPRIT programme.

On the basis of the preceding considerations, it is recommended that the System should promote communications between the industries of the region through publications, meetings and, possibly, the creation of a regional data network. It is suggested that this information should be as accurate as possible and relevant to the problems of industry, following such models as the UNIDO microelectronics newsletters. Along these same lines, it is likely that the regional institutions themselves will find it useful to establish mechanisms, such as a Latin American Microelectronics Industry Association, as a means of providing a solid basis for future co-operation in this field.

Governmental organizations

Considering the technological complexity of microelectronics and the associated investment burden, it is imperative that the Governments of the individual countries should establish priorities and the appropriate machinery to promote the development of this industry. The national policies of Brazil and Argentina, two countries that accord high priority to microelectronics and have laid the basis for its growth in integration with the expansion of the data-processing and telecommunications sectors, represent a regional advance that

should make it possible for the other countries to fine-tune their own policies in this field. The regional meetings on microelectronics sponsored by the Economic Commission for Latin America and the Caribbean (ECLAC), the Latin American Economic System (SELA) and UNIDO have provided excellent forums at which Latin American officials have had an opportunity to familiarize themselves with the experience, plans and programmes of the area countries, in addition to generating great interest in regional co-operation. The problems involved are too complex to have been exhaustively dealt with in the few meetings that have so far been held, and it might be suggested that, with the support of the regional agencies and of the System itself, a series of meetings having more specific agendas should be organized to permit more extensive coverage of governmental measures in respect of microelectronics. The subjects for discussion might be drawn from the reports of the previous meetings, with an effort made to focus the attention of the new meetings on specific items so as to permit the participation of officials in charge of general policy for the promotion of microelectronics together with representatives from other sectors of government involvement. These might be, depending on the circumstances, officials in charge of human resource training, scientific and technological research, telecommunications, data processing, financing, technology development projects for industry, governmental procurement policy, standardization, etc.

In this connection, the System should encourage each country to compile bibliographies on the reports, official documents, regulations and various sources of governmental information on microelectronics for the purpose of circulating these materials in the other countries of the region. Similarly, at the regional level, organizations such as SELA should be encouraged to perform a similar documentation function with respect to the information generated at events or in regional studies.

Structure of the REMLAC System

The essential idea of the System is to establish effective mechanisms to permit the flow of information and the organization of events so that projects may be implemented and the various countries kept informed not only of activities in the participating countries of the System itself, but also of international trends. The System will not have a structure of its own, but will rely on the structure that already exists; neither will it create any special Secretariat or additional machinery for its operation. The System's principle elements will be:

(1) The nodal points, i.e., the national centres or groups comprising the System. These may have different characteristics, but in general they will be institutions with a microelectronics research and development capacity. There will be only one nodal point per country, whereby the other national centres and institutions will make use of the country's nodal point for participation in the System. Each of the countries comprising the System must have a nodal point over the medium term. The System may assist those countries lacking sufficiently developed centres in establishing them and in training their personnel.

(2) Interaction within the System. The basis for the interaction of the nodal points will be provided through the meetings held by the System. These meetings will be organized on a rotating basis among the members and will lay down the System's areas and programmes of co-operation for the ensuing period. These programmes will be implemented by the participating countries.

(3) Internodal ties. It is necessary that stable channels should be established to permit the various nodal points of the System to interact among themselves. Consultation machinery, meetings and newsletters are

among the typical devices used for this purpose, in addition to personal contacts. Over the medium term consideration should be given to the possibility of establishing a data link between the System's various members to facilitate interaction and a rapid exchange of information.

(4) Regional nodal points. The System's regional nodal points, defined as "centres of excellence", would form the possible nodal points of the System. Considering the broad range of activities within the microelectronics field, the establishment of more than one regional nodal point might be necessary. From this perspective, and following an offer by the Government of Venezuela, a group of experts evaluated the facilities of the Engineering Institute Foundation (FII). This evaluation established the feasibility of FII's functioning as a regional nodal point, and proposals for its improvement will be submitted. It is anticipated that it will be necessary to identify specific regional nodal points in various areas.

(5) Financing. The System's activities will be financed by the countries themselves, UNDP and other international organizations. The budgets, extending over several years, are to be prepared at the meetings, and no project is to be begun if adequate financing has not been provided.

Recommendation of specific REMLAC actions

1. Multiproject chip

It is considered of great interest and importance that a joint and specific project be formulated as part of the activities of the System. It was generally agreed in the countries visited that the System's participating countries should formulate a project for the manufacture, at a silicon foundry to be selected, of a multiproject chip. Such a chip would consist of a series of circuits of commercial interest to each country, designed by each of them. This implies that each of the participating countries would, in co-operation with the others, develop a capacity for the design of highly complex integrated circuits. Each of the countries would finance its own infrastructure, and a project would be formulated for UNDP or some other international agency for the training and meetings necessary for carrying out the design and for covering the costs involved in disseminating the chip. From the point of view of the System, such a project would be of value, both in strategic and commercial terms, to the countries involved and would result in an installed infrastructure for the production of custom-designed circuits within the region.

2. Quality and production engineering for components and equipment

With the possible exception of Brazil, the region lacks extensive experience in quality control techniques and in electronic component and equipment production methodology. There is an evident need to implement a joint project to make it possible, specifically, to draw on the existing experience as a means of learning the various techniques of equipment evaluation and control. The basic idea would be to develop the necessary technology so as to achieve regionally the kind of procedures for test evaluation and standardization that will also satisfy international requirements. In addition, this activity would make it possible to increase the volume of exports. Dr. Dmitruk of Argentina's National Institute of Industrial Technology (INTI) will shortly be submitting a specific proposal for a joint project of this kind.

3. Standardization and certification of equipment

It would be desirable if within the region a number of generally accepted standards could be established for both components and equipment. This would lead to greater compatibility of products manufactured by the various sectors of the

industry, which in turn would permit the more extensive integration of equipment at the regional level. Moreover, the adoption of common standards would introduce a high level of compatibility for equipment manufactured within the region and greater independence on other, extra-regional, countries.

4. Communication and publicity

There must be greater communication between the countries comprising the System and greater publicity of all their activities, both of a commercial nature and in the area of research and development. This will be a very important task for the nodal points of the System. Consideration should also be given to the possibility of creating a System newsletter, of using already existing machinery and of establishing permanent sections on Latin American activities in already existing journals, such as the Journal de Microelectrónica (Brazil), the Revista Telegráfica Electrónica (Argentina) and TEC (Venezuela).

The System might also encourage the writing of articles on programmes, actions and achievements in regional microelectronics and promote their distribution to the principal newspapers as a means of generating a greater awareness of this subject.

There is likewise a need to publicize the work being performed by the research and development institutions of the region in order that machinery may be devised to provide assistance for specific tasks. Information should also be developed on the availability of microelectronics experts and consultants, both in the region's research and development institutions and its industry, whose services might be of value to other countries.

5. Notes on application

It would be desirable to formulate a Code containing notes on the application of devices, equipment, computation tools, specific standards, services and suppliers of microelectronics in order to save time and avoid a duplication of effort in the evaluation of already existing products in the Latin American countries. This Code might be centralized in one of the countries and could be fed through the evaluations conducted by the System's various institutions.

6. Purchase and acquisition of materials

Measures should be taken within the System to secure the supply of inputs and materials from other countries, as well as to improve the negotiating position of the countries by presenting a common front. Similarly, machinery should be set up to provide greater publicity and information on the suppliers of components and materials already operating in the region both within the existing electronics industry and at the research and development institutions.

7. Post-graduate support programmes

Support should be given to Latin American post-graduate training programmes in microelectronics. Specifically, the necessary machinery should be created for the exchange of teachers, the awarding of fellowships and the development of curricula, as well as for regional complementarity in various areas of microelectronics. In particular, it would be useful to design courses for the purpose of creating new groups in those areas of microelectronics not yet represented in every country.

ANNEX ON MEXICO FOR THE REPORT ON THE UNIDO MISSION PREPARATORY TO THE ESTABLISHMENT OF A REGIONAL SYSTEM FOR MICROELECTRONICS IN LATIN AMERICA (REMLAC)

Mexico is keenly interested in participating in REMLAC. This was made clear by Dr. José Warman, Director for the Electronics Industry and Industrial Co-ordination of the Ministry of Commerce and Industrial Promotion, who stressed the fact that for more than three years the Mexican Government had been lending its support to the organization of a regional meeting on microelectronics, noting that there was currently even greater interest in view of the advances that had been achieved in this field.

The attitude of industrialists, such as the President of the National Chamber of the Electronics Industry and Electrical Communications (CANIECE), and of the research community is also positive, there being an awareness of the advantages to be gained through the establishment of better communications with other regional countries and the undertaking of joint projects.

There has been a considerable acceleration in recent years in Mexican work in electronics. The industry, particularly in the telecommunications, data-processing, professional electronics and consumer-products branches, has grown rapidly to the accompaniment of increased integration with respect both to production and to engineering and technological advances.

In the telecommunications area, ambitious programmes have been launched to digitalize the country's telephone exchanges and expand the microwave and satellite communication systems. With respect to data-processing, more than 80 national manufacturers of microcomputers, peripheral apparatus and components have been successfully established, in addition to the manufacturers operating on the contractual buy-back principle ("maquiladores") and producing for the export market. In the field of professional electronics, using national technology several score products have been developed that are advantageously competing with similar foreign items. As far as consumer products are concerned, Mexico has begun the domestic production of television sets and radio receivers as a means of effectively competing with contraband imports. Domestic production has also been achieved in such areas as printed circuits and components, including transistors and resistors, under internationally competitive quality and price conditions.

Furthermore, in the research and development area, there are already important telecommunications groups, both in industry (the Telecommunications Development Institute (INDETELEC), Teléfonos de México, etc.) and at governmental institutes and centres of higher learning (the Telecommunications Research and Development Centre (CIDET), the Centre for Research and Advanced Studies of the National Polytechnical Institute (CINVESTAV), the Engineering Faculty of the National Autonomous University of Mexico (UNAM) and the new Telecommunications Institute, among others). In the field of data-processing as well, groups have been formed in industry (MEXEL, IBM, NCR, etc.) and at institutes, such as CINVESTAV, the Institute for Research in Applied Mathematics, Systems and Services (IMASS), the Instrument Centre, the University Computation Programme (these last three at UNAM), the Institute of Electrical Research (IIE), the Mexican Petroleum Institute (IMP), etc. In professional electronics there have been developments in many industries, the majority in collaboration with such institutes as IIE, IMP, the regional technological institutes, the Autonomous Metropolitan University (UAM), the Institute of Engineering at UNAM, and others. Work is also going forward with computer-assisted design and computer-assisted manufacturing at many of these

institutes. Component-associated research and development is concentrated at the institutions of higher learning, among which particular mention should be made of the University of Puebla, CINVESTAV, the Institute of Physics and the Institute of Materials of UNAM, as well as the National Institute of Astrophysics, Optics and Electronics (INAOE). This work is primarily concerned with silicon (polycrystal, monocrystal and amorphous) and with the design and production of integrated circuits.

At practically all the groups mentioned there is a previous history of interaction with other Latin American countries, particularly through visits, information exchanges and participation in regional technical meetings.

There is an awareness of the inadequacy of co-operation in the microelectronics area among the research groups and industry. This is due primarily to the fact that industrial development in this field is still in its infancy and the groups engaged in the design and development of equipment and devices have not displayed an interest in the more extensive use of customized and semicustomized integrated circuits. But this trend, which is becoming daily more evident in countries like the United States of America, is beginning to make itself felt, and there is already keen interest in the establishment of an electronics industry support centre to facilitate the work of design, co-operation with silicon foundries and, in general, prototype development and evaluation.

The Mexican Government is directing particular attention to the development of the electronics industry and, to this end, is preparing a "comprehensive programme for the development of the electronics industry" (PIDIE), which will supplement the growth that has already been achieved in recent years by promoting industries, mainly in the computer area, and by extending coverage at this time to professional electronics, consumer electronics, biomedical electronics, microelectronics and software.

This programme includes the encouragement of electronics production through conventional measures of promotion in co-ordination with the development of applications of interest to the quasi-governmental sector, which is also expected to participate in and support the growth of new electronics industries. The strategy adopted envisages a series of measures of a scientific and technological nature that are to be carried out in concert with industry and the country's research and development community for the purpose of facilitating industry activities in this field. Among these measures there are plans to strengthen the research and development groups capable of generating electronic applications and to create technological support services to work together with industry in the design, development and production of prototypes and in technological support for the industrial-scale manufacturing of this equipment.

To this end, there is to be a restructuring of the service centre already mentioned, which will draw on the support of the quasi-governmental sector and private enterprise. This centre is being organized with the support of the Ministry of Commerce and Industrial Promotion, the Ministry of Energy, Mining and Quasi-Governmental Industry, the Institute of Electrical Research, and the National Chamber of the Electronics Industry and Electrical Communications. By virtue of its functions, this centre will represent an appropriate nodal point for the REMLAC System.

Abbreviations

CIDET	Telecommunications Research and Development Centre. It is part of the Ministry of Communications and Transport.
CINVESTAV	Centre for Research and Advanced Studies of the National Polytechnical Institute
IMASS	Institute of Research in Applied Mathematics, Systems and Services. It is subordinate to the National Autonomous University of Mexico (UNAM).
IIE	Institute of Electrical Research
IMP	Mexican Petroleum Institute
UAM	Autonomous Metropolitan University
INAOE	National Institute of Astrophysics, Optics and Electronics
SECOFI	Ministry of Commerce and Industrial Promotion
SEMIP	Ministry of Energy, Mining and Quasi-Governmental Industry
CANIECE	National Chamber of the Electronics Industry and Electrical Communications